Compound microscope

Microscopes are instruments that are used in science laboratories to visualize very minute objects such as cells, and microorganisms, giving a contrasting image that is magnified. Microscopes are made up of lenses for magnification, each with its own magnification powers. Depending on the type of lens, it will magnify the specimen according to its focal strength. A simple light microscope manipulates how light enters the eye using a convex lens, where both sides of the lens are curved outwards. When light reflects off of an object being viewed under the microscope and passes through the lens, it bends towards the eye. This makes the object look bigger than it actually is. There are two sets of lenses in the compound microscope. an objective lens, which is closer to the object, and an eyepiece, which is the lens you look through. The eyepiece lens typically magnifies an object to appear ten times its actual size, while the magnification of the objective lens can vary. Compound microscopes can have up to four objective lenses of different magnifications, and the microscope can be adjusted to choose the magnification that best suits the viewer's needs. The total magnification that a certain combination of lenses provides is determined by multiplying the magnifications of the eyepiece and the objective lens being used. For example, if both the eyepiece and the objective lens magnify an object ten times, the object would appear one hundred times larger. The compound microscope is typically used for observing objects at the cellular level.

History:

Sometime about the year 1590, two Dutch spectacle makers, **Zacharias Janssen and his father Hans** started experimenting with these lenses. They put several lenses in a tube and made a very important discovery. The object near the end of the tube appeared to be greatly enlarged, much larger than any simple magnifying glass could achieve by itself! They had just invented the compound microscope (which is a microscope that uses two or more lenses). **Galileo h**eard of their experiments and started experimenting on his own. He described the principles of lenses and light rays and improved both the microscope and telescope. He added a focusing device to his microscope and of course went on to explore the heavens with his telescopes. **Anthony Leeuwenhoek** of Holland became very interested in lenses while working with magnifying glasses in a dry goods store. He used the

magnifying glass to count threads in woven cloth. He became so interested that he learned how to make lenses. By grinding and polishing, he was able to make small lenses with great curvatures. These rounder lenses produced greater magnification, and his microscopes were able to magnify up to 270X! Anthony Leeuwenhoek became more involved in science and with his new improved microscope was able to see things that no man had ever seen before. He saw bacteria, yeast, blood cells and many tiny animals swimming about in a drop of water. From his great contributions, many discoveries and research papers, Anthony Leeuwenhoek (1632-1723) has since been called the "Father of Microscopy". **Robert Hooke**, an Englishman (who is sometimes called the “English Father of Microscopy”), also spent much of his life working with microscopes and improved their design and capabilities. Little was done to improve the microscope until the middle of the 19th century when great strides were made and quality instruments like today’s microscope emerged. Companies in Germany like Zeiss and an American company founded by Charles Spencer began producing fine optical instruments.

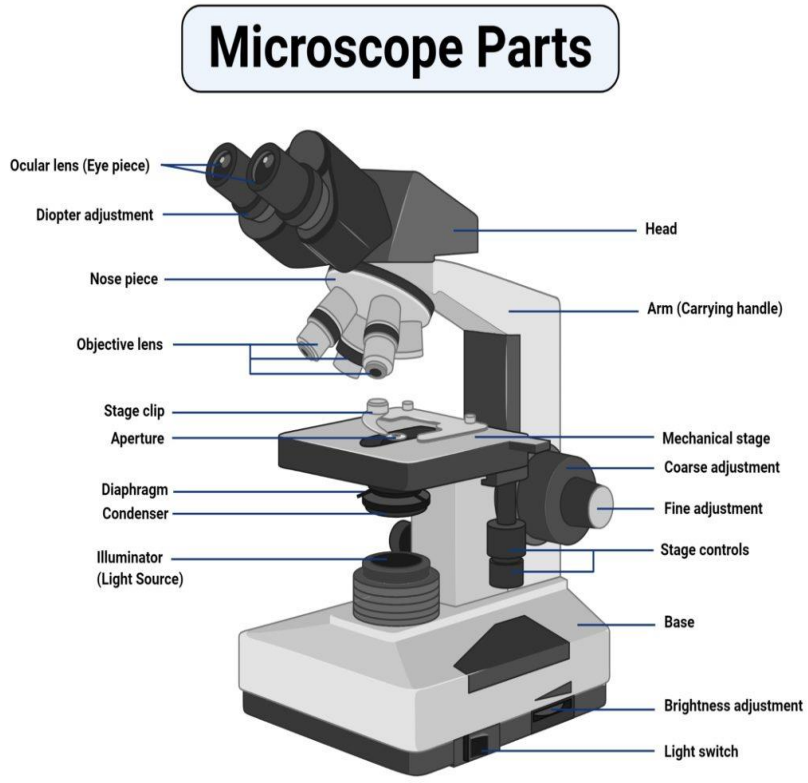

Figure: Parts of a microscope, Image Copyright © Sagar Aryal, www.microbenotes.com

There are three structural parts of the microscope i.e. head, base, and arm.

1. **Head** – This is also known as the body. It carries the optical parts in the upper part of the microscope.
2. **Base** – It acts as microscopes support. It also carries microscopic illuminators.
3. **Arms** – This is the part connecting the base and to the head and the eyepiece tube to the base of the microscope. It gives support to the head of the microscope and it is also used when carrying the microscope. Some high-quality microscopes have an articulated arm with more than one joint allowing more movement of the microscopic head for better viewing.

Optical parts of a microscope and their functions

1. **Eyepiece** – also known as the ocular. This is the part used to look through the microscope. Its found at the top of the microscope. Its standard magnification is 10x with an optional eyepiece having magnifications from 5X to 30X.
2. **Eyepiece tube** – it's the eyepiece holder. It carries the eyepiece just above the objective lens. In some microscopes such as the binoculars, the eyepiece tube is flexible and can be rotated for maximum visualization, for variance in distance. For monocular microscopes, they are nonflexible.
3. **Objective lenses** – These are the major lenses used for specimen visualization. They have a magnification power of 40x-100X. There are about 1- 4 objective lenses placed on one microscope, in that some are rare facing and others face forward. Each lens has its own magnification power.
4. **Nose piece** – also known as the revolving turret. It holds the objective lenses. It is movable hence it can revolve the objective lenses depending on the magnification power of the lens.
5. **The Adjustment knobs** – These are knobs that are used to focus the microscope. There are two types of adjustment knobs i.e fine adjustment knobs and coarse adjustment knobs.

6. **Stage** – This is the section in which the specimen is placed for viewing. They have stage clips that hold the specimen slides in place. The most common stage is the mechanical stage, which allows the control of the slides by moving the slides using the mechanical knobs on the stage instead of moving them manually.
7. **Aperture** – This is a hole on the microscope stage, through which the transmitted light from the source reaches the stage.
8. **Microscopic illuminator** – This is the microscopes light source, located at the base. It is used instead of a mirror. It captures light from an external source of a low voltage of about 100v.
9. **Condenser** – These are lenses that are used to collect and focus light from the illuminator into the specimen. They are found under the stage next to the diaphragm of the microscope. They play a major role in ensuring clear sharp images are produced with a high magnification of 400X and above. The higher the magnification of the condenser, the more the image clarity. More sophisticated microscopes come with an Abbe condenser that has a high magnification of about 1000X.
10. **Diaphragm** – it's also known as the iris. Its found under the stage of the microscope and its primary role is to control the amount of light that reaches the specimen. It's an adjustable apparatus, hence controlling the light intensity and the size of the beam of light that gets to the specimen. For high-quality microscopes, the diaphragm comes attached with an Abbe condenser and combined they are able to control the light focus and light intensity that reaches the specimen.
11. **Condenser focus knob** – this is a knob that moves the condenser up or down thus controlling the focus of light on the specimen.
12. **Abbe Condenser** – this is a condenser specially designed for high-quality microscopes, which makes the condenser to be movable and allows very high magnification of above 400X. High-quality microscopes normally have a high numerical aperture than objective lenses.